2004 SPRING LAKE TROUT ASSESSMENT

INTRODUCTION

Lake trout were nearly extirpated in Lake Superior during the 1950s due to over-fishing and sea lamprey predation. Sea lamprey control, reduction of commercial fishing and establishment of refuges have contributed to the increase of lake trout abundance in Wisconsin waters. However, lake trout population characteristics are still important to determine the progress of rehabilitation. Biological data collected are required for critical management decisions such as setting the lake trout quota and recreational fishing regulations. The objective of the spring lake trout assessment is to monitor lake trout population dynamics such as abundance, diet, and sea lamprey wounding rates.

METHODS

Thirty stations were sampled in the Apostle Islands (WI-2) (Figure 1) with the R/V *Hack Noyes*. Each site was sampled with 2,700 ft of multifilament nylon gill net with 4.5-in stretch mesh. Nets were set for one night (24 hr) at each station.

Sixteen stations were sampled in western Wisconsin waters (WI-1) (Figure 1) with the R/V *Hack Noyes*. Each site was sampled with 900 ft of multifilament nylon gill net with 4.5-in stretch mesh. Nets were set for one night (24 hr) at each station.

All live fish were measured (total length), tagged, checked for sea lamprey marks and fin-clips, and then released. Dead fish were processed in the same manner except stomach contents were collected and frozen, individual weights were taken when lake conditions permitted, scale samples were taken, and otoliths removed from native lake trout longer than 23.0 in. Although whitefish were not tagged they were processed similarly to lake trout.

Fish ages were estimated using scales and otoliths. Mean length-at-age was estimated by combining spring lake trout data from 2002 through 2004 because age was estimated for a low number of fish in each year.

Following the protocol established by the Lake Superior Technical Committee, diet was analyzed by examination of stomach contents. Frequency of occurrence, percent composition by number, and percent composition by weight of food items were calculated from the stomach contents.

RESULTS/DISCUSSION

SEA LAMPREY WOUNDING

Sea lamprey wounding data are collected annually to monitor the effectiveness of control programs and follow trends. Sea lamprey wounding has been consistently lower in WI-2 than

WI-1 (Table 1 and 2). Wounding rates increased for all size categories in WI-1 from 2003 to 2004 (Table 1).

LAKE TROUT - CATCH STATISTICS

In 2004, 460 lake trout were captured within WI-2. Native fish comprised 93% of the lake trout catch. Mean length of native lake trout was 23.4 in (SD = 3.75)(Figure 2). Geometric mean catch-per-unit-effort (CPUE) of native fish increased 2% from 2003 to 2004 (Figure 3, Table 3). Mean length of hatchery-reared lake trout was 24.3 in (SD = 4.3)(Figure 2). Geometric mean CPUE of hatchery fish decreased 11% from 2003 to 2004 (Figure 3, Table 3).

In 2004, 153 lake trout were sampled within WI-1. Native lake trout abundance has been gradually increasing and wild fish accounted for 52.3% of the catch. Mean length of native fish was 23.6 in (SD = 3.0)(Figure 4). Geometric mean CPUE of native fish increased from 2003 to 2004 (Figure 5, Table 4). Mean length of hatchery lake trout was 25.3 in (SD = 3.9)(Figure 4). Geometric mean CPUE of hatchery fish did not change from 2003 to 2004 (Figure 5, Table 4).

LAKE TROUT - MEAN LENGTH-AT-AGE

Mean age of lake trout captured in WI-1 was 9 (5-21) for native fish and 8 (3-21) for hatchery fish from 2002 through 2004 (Table 5). Mean age of lake trout captured in WI-2 was 9 (4-31) for native fish and 8 (2-12) for hatchery fish (Table 5).

LAKE TROUT - DIET ANALYSIS

In 2004, the stomach contents of 149 lake trout from WI-1 and WI-2 were examined (38 were empty). Terrestrial insects constituted the largest percentage of native lake trout diet by number, but rainbow smelt were present in more stomachs and constituted more of the lake trout's diet by weight (Table 6).

REHABILITATION PROGRESS

Native lake trout abundance continues to increase within WI-2 and WI-1. Lake trout stocking is no longer necessary in WI-2 and the 1994 year class was the last to be stocked. This is a sign of continued progress in lake trout rehabilitation. Maintenance of the refuges in combination with sport and commercial regulations, and sea lamprey control, are needed for rehabilitation to continue. Lake trout will continue to be stocked in WI-1 until the stocking protocol established by the Lake Superior Technical Committee indicates otherwise.

SISCOWETS

Few siscowet (fat) lake trout were caught during the spring lean lake trout assessment (Table 7 and 8). Abundance has increased over the years, but sampling does not occur in siscowet habitat, consequently trends may only be marginal indicators of abundance.

WHITEFISH CATCH STATISTICS

In 2004, 557 whitefish were captured in WI-2 (mean length = 18.9, SD = 1.2)(Figure 6). Geometric mean CPUE of whitefish decreased from 2003 to 2004, however their abundance has increased since the early 1980s (Figure 7).

In 2004, 57 whitefish were captured in WI-1 (mean length = 18.5, SD = 1.5)(Figure 6). Geometric mean CPUE of whitefish decreased from 2003 to 2004 (Figure 7). Whitefish abundance in WI-1 has increased slowly since1987 but has been much lower than in WI-2. The majority of whitefish captured in WI-1 are at sites in the eastern end of the management area.

Table 1. Sea lamprey wounds per 100 lake trout from spring assessment, 4.5-in nylon gill nets (sample size) in WI-1, 1987-2004.

Year	< 17"	17-20.9"	21-24.9"	25-28.9"	28.9"<	Total
1987	0.0 - (6)	8.7 - (208)	18.8 - (335)	31.4 - (105)	66.7 - (9)	18.1 - (663)
1988	0.0 - (5)	7.5 - (40)	11.6 - (241)	22.2 - (117)	0.0 - (10)	13.8 - (413)
1989	0.0 - (4)	3.2 - (62)	12.4 - (209)	16.4 - (152)	31.6 - (19)	13.2 - (446)
1990	0.0 - (14)	2.8 - (144)	16.1 - (112)	28.6 - (98)	33.3 - (15)	14.4 - (383)
1991	0.0 - (11)	6.7 - (102)	15.0 - (140)	19.8 - (86)	11.1 - (9)	13.2 - (348)
1992	0.0 - (5)	6.3 - (64)	17.9 - (95)	34.0 - (47)	16.7 - (12)	17.5 - (223)
1993	0.0 - (22)	0.0 - (98)	14.4 - (187)	23.0 - (148)	29.2 - (41)	14.7 - (496)
1994	0.0 - (32)	0.0 - (59)	13.0 - (54)	5.8 - (52)	0.0 - (16)	4.7 - (213)
1995	0.0 - (6)	1.0 - (101)	6.3 - (126)	14.1 - (85)	14.8 - (27)	7.2 - (345)
1996	No Sampling					
1997	0.0 – (39)	0.0 – (71)	7.8 – (115)	11.6 – (86)	26.7 – (30)	7.9 – (341)
1998	0.0 - (32)	1.4 - (69)	2.9 - (69)	7.3 - (55)	41.2 - (17)	5.8 - (242)
1999	0.0 – (25)	0.0 – (116)	1.1 – (181)	2.4 – (41)	15.8 – (19)	1.6 – (382)
2000	9.1 – (11)	1.5 – (65)	5.3 – (169)	16.7 – (36)	100 – (16)	11.1 – (297)
2001	No Sampling					
2002	0.0 – (6)	2.1 – (48)	1.3 – (159)	19.3 – (109)	38.3 – (47)	11.4 – (369)
2003	0.0 – (4)	0.0 – (21)	4.5 – (66)	4.3 – (47)	21.7 – (23)	6.2 – (161)
2004	0.0 – (1)	0.0 – (18)	5.6 – (72)	6.4 – (47)	53.3 – (15)	9.8 – (153)

Table 2. Sea lamprey wounds per 100 lake trout from spring assessment, 4.5-in nylon gill nets (sample size) in WI-2, 1985-2004.

Year	< 17"	17-20.9"	21-24.9"	25-28.9"	28.9"<	Total
1985	1.9 - (52)	3.2 - (318)	6.7 - (556)	7.9 - (241)	12.5 - (32)	6.0 - (1,199)
1986	1.7 - (58)	1.3 (550)	6.7 - (935)	10.3 - (377)	11.9 - (42)	5.9 - (1,962)
1987	0.0 - (42)	2.5 - (600)	6.2 - (753)	14.9 - (262)	21.1 - (38)	6.4 - (1,695)
1988	2.9 - (34)	1.1 - (357)	8.4 - (464)	13.8 - (246)	20.4 - (54)	7.7 - (1,155)
1989	0.0 - (23)	2.3 - (478)	7.0 - (742)	11.3 - (432)	16.0 - (50)	7.0 - (1,725)
1990	0.0 - (35)	1.9 - (471)	3.7 - (484)	10.6 - (339)	8.3 - (84)	5.0 - (1,413)
1991	1.7 - (58)	1.8 - (391)	4.5 - (584)	6.7 - (374)	11.3 - (106)	4.7 - (1,513)
1992	0.0 - (45)	1.6 - (316)	9.2 - (601)	12.4 - (315)	23.0 - (74)	8.6 - (1,351)
1993	0.0 - (59)	1.0 - (302)	5.6 - (393)	6.0 - (318)	10.5 - (105)	4.7 - (1,177)
1994	0.0 - (58)	0.9 - (230)	1.2 - (485)	3.0 - (370)	8.2 - (98)	2.2 - (1,241)
1995	0.0 - (30)	0.7 - (426)	1.9 - (643)	7.2 - (375)	8.7 - (127)	3.3 - (1,601)
1996	No Sampling					
1997	0.0 – (90)	0.3 – (356)	2.1 – (533)	4.9 (347)	5.1 – (158)	2.5 – (1,484)
1998	0.0 - (46)	0.6 - (357)	0.9 - (462)	4.8 - (147)	8.6 - (93)	1.9 - (1,105)
1999	0.0 – (37)	0.8 – (479)	1.0 – (707)	2.9 – (138)	10.1 – (99)	1.7 – (1460)
2000	0.0 – (33)	0.9 – (437)	4.3 – (1036)	15.4 – (247)	31.8 – (107)	6.5 – (1860)
2001	No Sampling					
2002	0.0 – (17)	0.0 – (166)	3.3 – (398)	7.4 – (203)	23.4 – (64)	5.1 – (848)
2003	0.0 - (8)	0.0 - (62)	2.5 - (244)	5.1 - (98)	12.5 - (40)	3.5 - (452)
2004	0.0 - (6)	0.8 - (131)	2.8 - (179)	5.4 - (112)	9.4 - (32)	3.3 - (460)

Table 3. Catch data for spring sampled lake trout in 4.5-in nylon gill nets from WI-2, 1981-2004. Nets were set for three nights from 1981-2000 and for one night since 2002.

Year	Effort (Feet)	Sample Size	Native Sample Size	Native Geometric Mean CPUE	Native Mean Length (in)	% Native	Hatchery Geometric Mean CPUE
1981	63,300	763	227	5.1	23.9	29.9	11.1
1982	90,000	814	250	2.6	23.5	30.7	5.6
1983	17,400	139	43	2.5	24.1	30.9	5.5
1984	18,000	208	62	2.9	23.7	29.8	9.0
1985	78,300	1,303	459	3.5	23.2	35.2	6.9
1986	88,200	2,093	1,039	8.1	22.7	49.7	8.9
1987	83,700	1,730	1,047	7.0	22.2	60.5	6.9
1988	83,700	1,166	628	6.2	23.1	53.9	5.4
1989	83,700	1,728	954	8.9	23.6	55.2	6.6
1990	83,700	1,395	883	7.4	23.6	63.3	4.5
1991	83,700	1,487	1,031	8.5	23.5	69.3	4.9
1992	83,700	1,351	967	8.5	23.6	71.6	3.7
1993	83,700	1,176	893	9.5	24.0	75.9	3.4
1994	83,700	1,241	967	10.2	24.0	77.9	3.3
1995	83,700	1,601	1,132	12.1	23.8	70.7	3.4
1996				No Sampling			
1997	83,700	1,484	1,032	11.2	24.4	69.5	4.0
1998	83,700	1,105	775	8.0	23.2	70.1	3.0
1999	83,700	1460	926	11.2	22.9	63.4	4.8
2000	83,700	1860	1233	14.9	23.3	66.3	5.7
2001				No Sampling			
2002	83,700	848	719	21.5	23.7	84.8	3.4
2003	81,000	452	414	12.4	24.0	91.6	0.9
2004	83,700	460	428	12.6	23.4	93.0	0.8

Table 4. Catch data for spring sampled lake trout in 4.5-in nylon gill nets from WI-1, 1987-2004. Nets were set for three nights from 1987-2000 and for one night since 2002.

Year	Effort (Feet)	Sample Size	Native Sample Size	Native Geometric Mean CPUE	Native Mean Length (in)	% Native	Hatchery Geometric Mean CPUE
1987	17,100	665	85	0.8	20.7	12.8	3.0
1988	17,100	415	35	0.5	23.0	8.4	2.2
1989	17,100	449	29	0.3	21.7	6.5	2.0
1990	17,100	384	52	0.6	20.5	13.5	1.9
1991	17,100	348	68	0.8	22.0	19.5	2.0
1992	17,100	223	68	0.7	21.3	30.5	1.6
1993	17,100	496	103	1.1	21.6	20.8	2.7
1994	17,100	213	62	0.8	21.6	29.1	1.5
1995	17,100	345	146	1.4	22.3	43.2	2.1
1996				No Sampling			
1997	17,100	341	137	1.4	23.2	40.2	2.1
1998	17,100	242	90	1.0	23.1	37.2	1.6
1999	17,100	382	101	1.1	22.7	26.4	2.5
2000	17,100	297	109	1.5	22.3	36.7	2.4
2001				No Sampling			
2002	14,400	369	125	2.6	23.9	33.9	3.7
2003	14,400	161	48	1.2	22.9	29.8	2.2
2004	14,400	153	80	2.1	23.6	52.3	2.2

Table 5. Mean length-at-age of wild and hatchery lake trout from Wisconsin waters of Lake Superior, 2000-2004.

	WI-1				WI-2			
	Wild		Hatchery		Wild		Hatchery	
Age	Mean	N	Mean	N	Mean	N	Mean	N
2							9.2	1
3			9.5	1			11.9	1
4			20.0	2	12.6	1	17.2	4
5	19.7	1	19.0	8	17.2	11	19.7	1
6	19.4	28	20.7	6	19.5	18	21.8	8
7	21.1	23	21.5	4	21.4	24	21.5	3
8	23.3	23	23.8	14	22.0	25	21.9	9
9	24.3	10	24.4	8	23.2	33	23.0	10
10	24.2	9	24.7	8	24.3	24	24.6	9
11	25.4	7	23.8	5	25.4	17	24.6	1
12	25.0	8	26.4	1	24.6	13	25.7	1
13	26.8	6			26.5	6		
14	25.4	2	28.5	4	27.7	1		
15	25.5	1			29.5	2		
16	28.6	1			25.6	1		
17	26.9	17						
18	27.7	1			32.2	1		
19	29.5	1						
21	31.1	1	33.9	1				
31					35.8	1		

Table 6. Diet composition of lake trout captured from WI-1 and WI-2 in 2004 (percent frequency of occurrence (%FO), items found (IF), percent composition by number (%CN), total item weight (g) (IW), percent composition by weight (%CW), and mean length of prey (in) (MLP)).

	Wild							Hatchery						
No. examined	119							30						
No. empty (%)	32(27)							6(20)						
Food Item	Occurrence	%FO	IF	%CN	IW (g)	%CW	MLP (in)	Occurrence	%FO	IF	%CN	IW (g)	%CW	MLP (in)
Herring	3	2.5	3	0.3	308.0	8.6	10.8	0	0.0	0	0.0	0.0	0.0	0.0
Coregonus Sp.	7	5.9	8	0.7	316.0	8.8	9.9	2	6.7	2	1.5	29.0	4.4	*
Rainbow Smelt	52	43.7	195	18.0	1846.5	51.4	4.9	15	50.0	57	41.6	414.8	63.4	4.5
Burbot	5	4.2	10	0.9	332.0	9.2	5.6	0	0.0	0	0.0	0.0	0.0	0.0
Sculpins	5	4.2	8	0.7	27.0	0.8	2.3	0	0.0	0	0.0	0.0	0.0	0.0
Sticklebacks	5	4.2	5	0.5	9.0	0.3	2.3	0	0.0	0	0.0	0.0	0.0	0.0
Unidentified Fish	49	41.2	166	15.3	677.5	18.9	*	21	70.0	61	44.5	208.5	31.9	*
Mysis relicta	0	0.0	0	0.0	0.0	0.0	*	1	3.3	16	11.7	0.0	0.0	*
Aphipods	4	3.4	245	22.6	15.0	0.4	*	0	0.0	0	0.0	0.0	0.0	*
Terrestrial Insects	5	4.2	400	36.9	61.0	1.7	*	0	0.0	0	0.0	0.0	0.0	*
Other	3	2.5	43	4.0	1.0	0.0	*	1	3.3	1	0.7	2.0	0.3	*
Total			1083		3593.0					137		654.3		

*No data available to calculate value

Table 7. Catch data of siscowet lake trout from WI-2, 1981-2004. Nets were set for three nights from 1981-2000 and for one night since 2002.

Year	Effort (ft)	Sample Size	Fish/1000 ft	CPUE > 25”	Mean Length (in)
1981	63,300	1	0.16	0.16	25.2
1982	90,000	0	--	--	--
1983	17,400	7	0.40	--	20.3
1984	18,000	20	1.10	0.14	20.5
1985	78,300	0	--	--	--
1986	88,200	1	0.01	--	22.4
1987	83,700	9	0.11	--	21.5
1988	83,700	7	0.08	--	20.5
1989	83,700	17	0.2	--	21.5
1990	83,700	9	0.11	0.036	24.2
1991	83,700	29	0.50	0.036	21.9
1992	83,700	22	0.26	0.024	22.1
1993	83,700	40	0.48	0.036	21.7
1994	83,700	42	0.50	0.012	21.1
1995	83,700	30	0.36	0.06	22.3
1996			No Sampling		
1997	83,700	30	0.36	0.13	22.5
1998	83,700	45	0.18	0.18	23.4
1999	83,700	41	0.50	0.07	21.4
2000	83,700	70	0.84	0.18	22.5
2001			No Sampling		
2002	83,700	21	0.30	--	22.7
2003	81,000	24	0.30	0.05	22.7
2004	83,700	9	0.11	0.04	23.0

Table 8. Catch data of siscowet lake trout from WI-1, 1987-2004. Nets were set for three nights from 1987-2000 and for one night since 2002.

Year	Effort (feet)	Sample Size	Fish/1000 ft	CPUE > 25”	Mean Length (in)
1987	17,100	1	0.06	--	17.6
1988	17,100	1	0.06	--	20.0
1989	17,100	0	--	--	--
1990	17,100	2	0.12	0.06	22.9
1991	17,100	6	0.35	0.06	20.6
1992	17,100	1	0.06	0.06	27.8
1993	17,100	16	0.94	--	--
1994	17,100	1	0.06	--	--
1995	17,100	1	0.06	--	20.7
1996			No Sampling		
1997	17,100	8	0.47	0.23	25.5
1998	17,100	31	1.8	0.82	22.8
1999	17,100	14	0.82	0.11	20.8
2000	17,100	6	0.35	0.12	23.2
2001			No Sampling		
2002	14,400	1	0.1	--	17.5
2003	14,400	8	0.55	0.35	26.2
2004	14,400	2	0.14	--	21.9

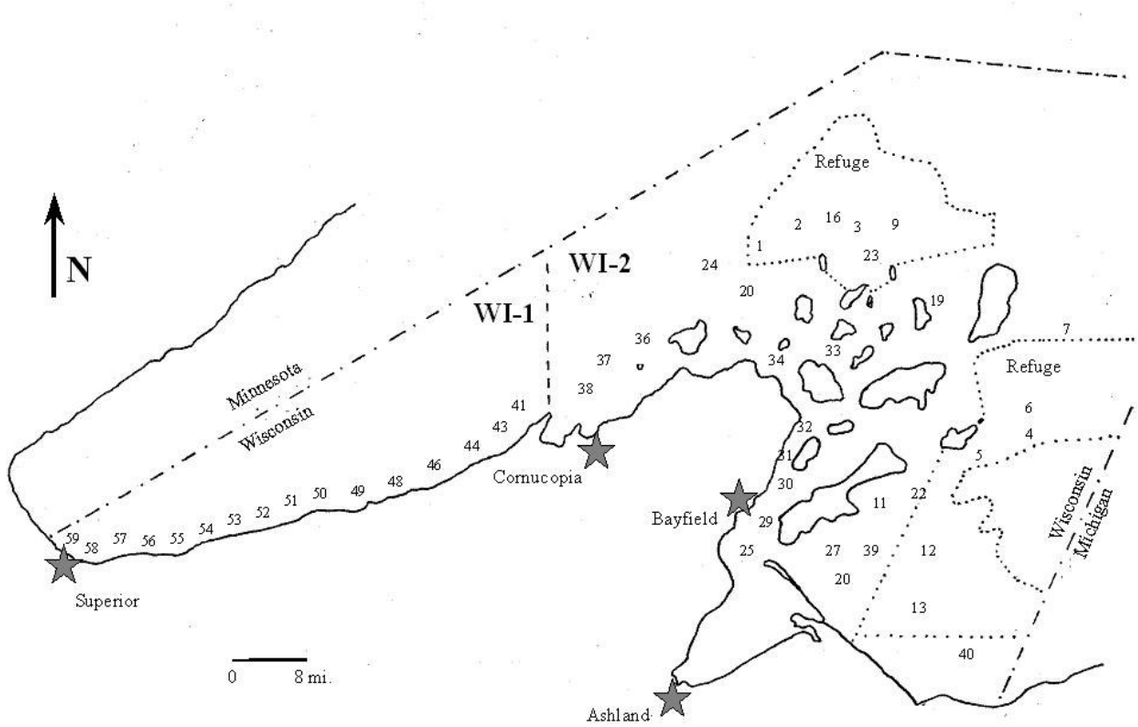

Figure 1. Gill net sites for spring lake trout assessment in the Wisconsin waters of Lake Superior, 2004. Wisconsin waters are divided into two management regions, WI-1 and WI-2.

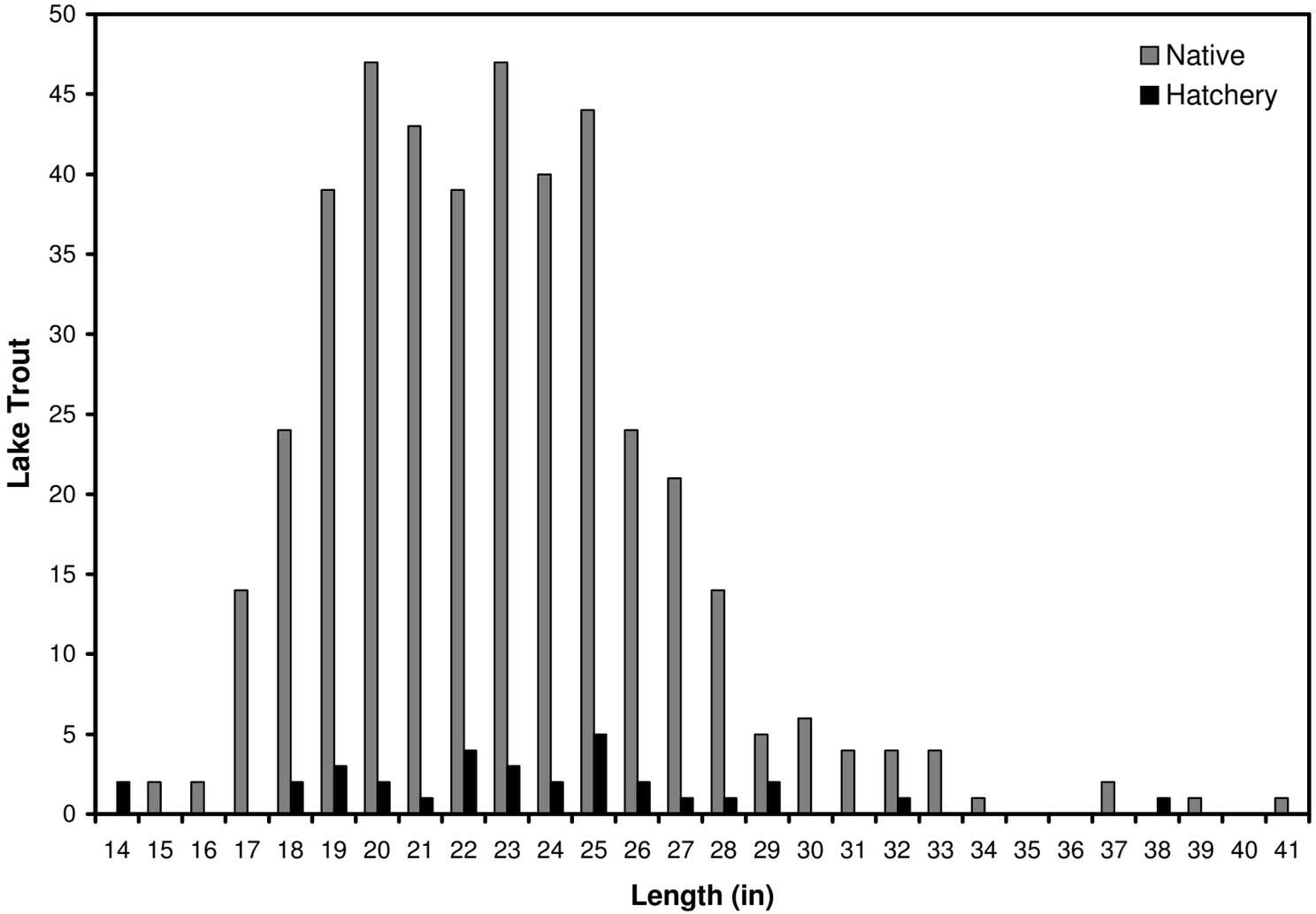

Figure 2. Length frequency of native and hatchery lake trout caught in WI-2, 2004.

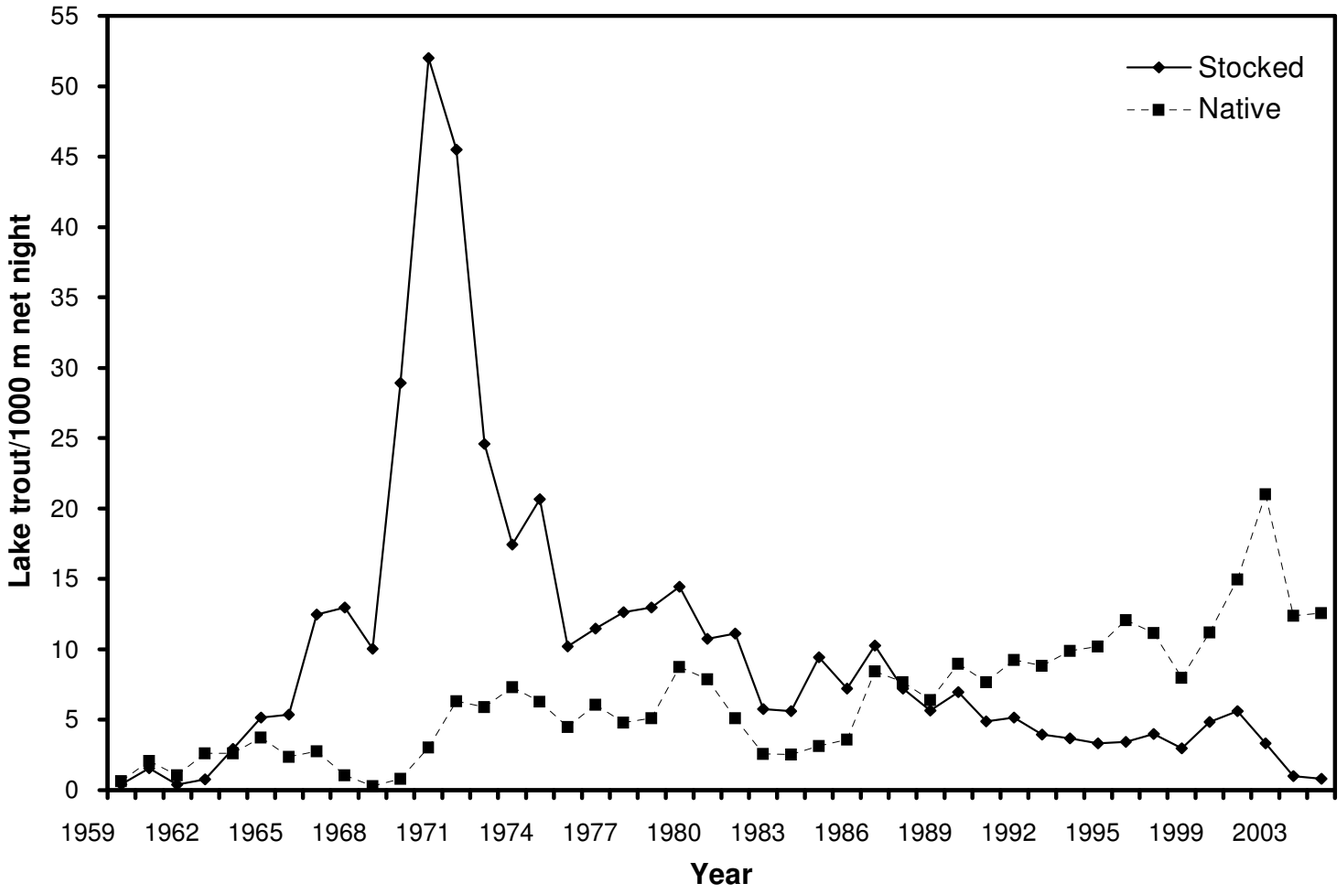

Figure 3. Geometric mean catch-per-unit-effort of native and hatchery lake trout in WI-2, 1959-2004. Lake trout were not sampled in 1996 and 2001.

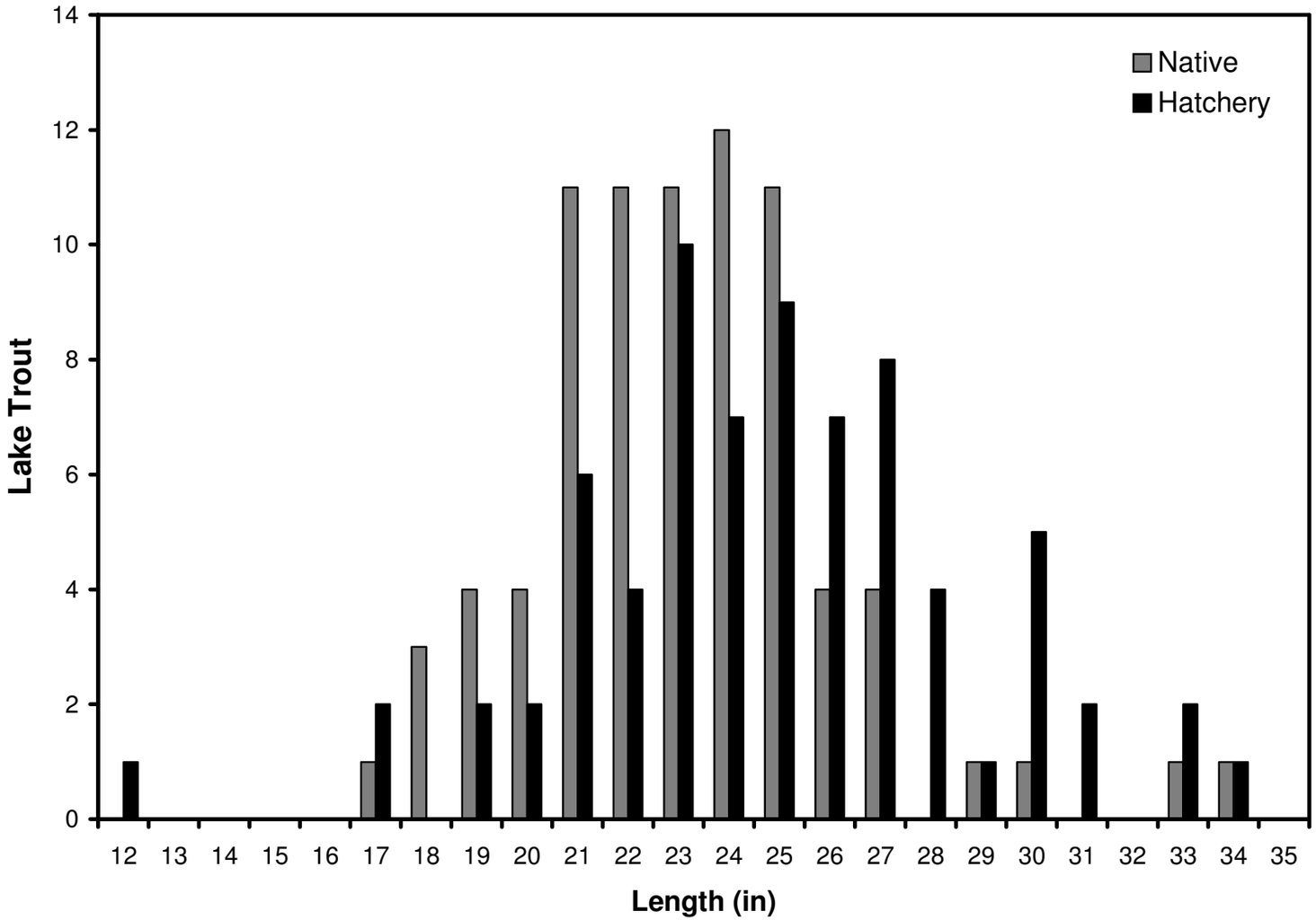

Figure 4. Length frequency of native and hatchery lake trout caught in WI-1, 2004.

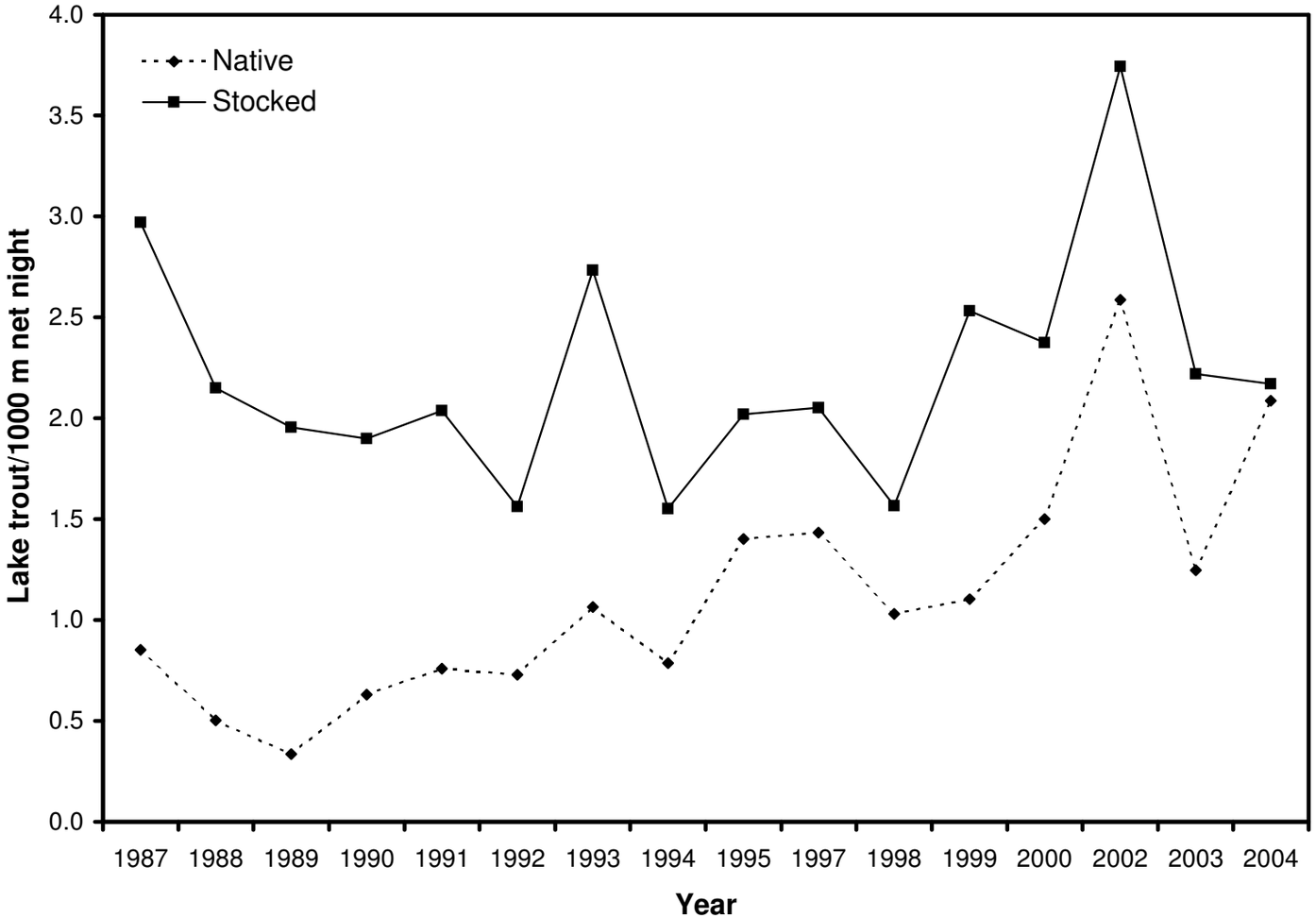

Figure 5. Geometric mean catch-per-unit-effort of native and hatchery lake trout in WI-1, 1987-2004. Lake trout were not sampled in 1996 and 2001.

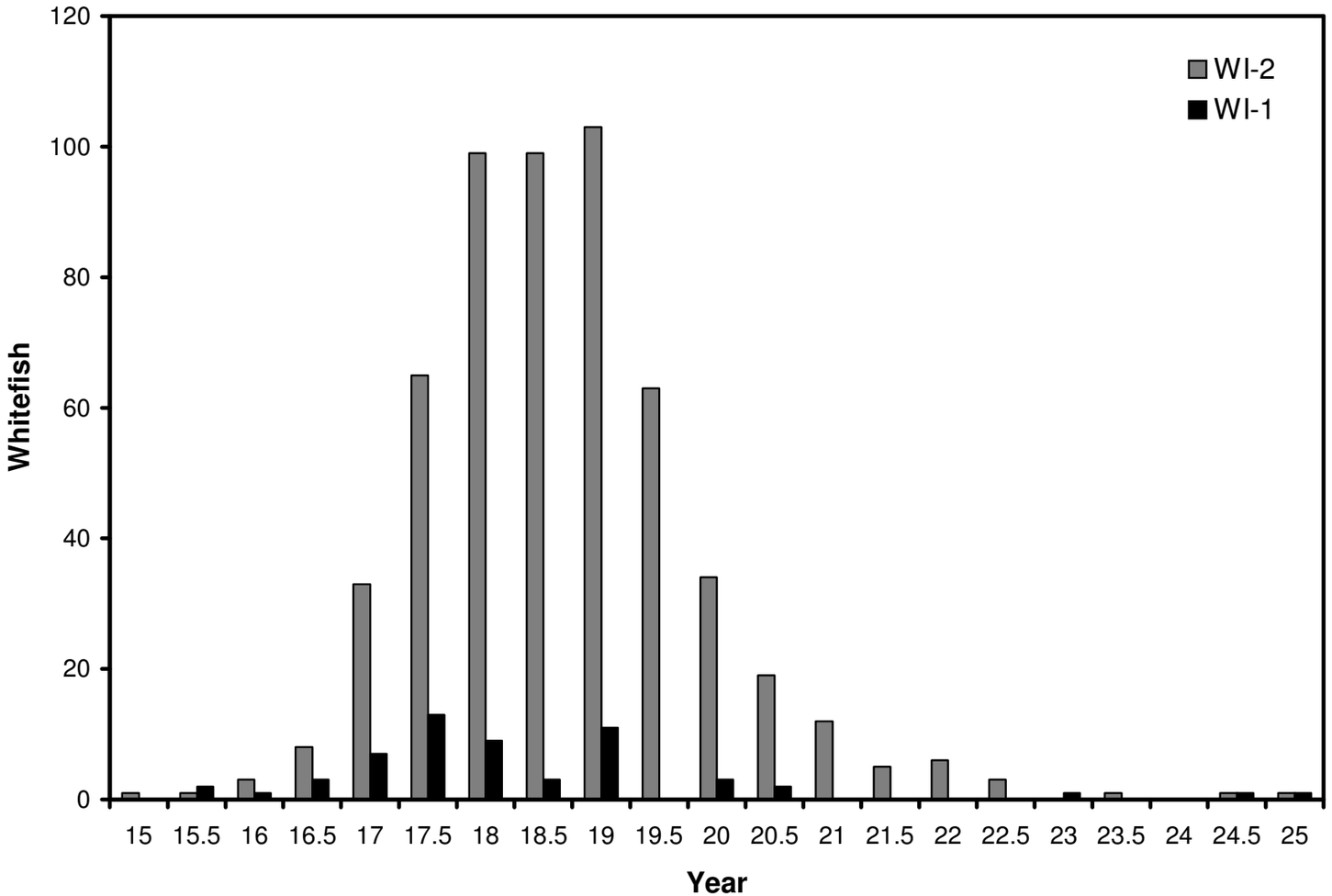

Figure 6. Length frequency of whitefish captured in Wisconsin waters of Lake Superior, 2004.

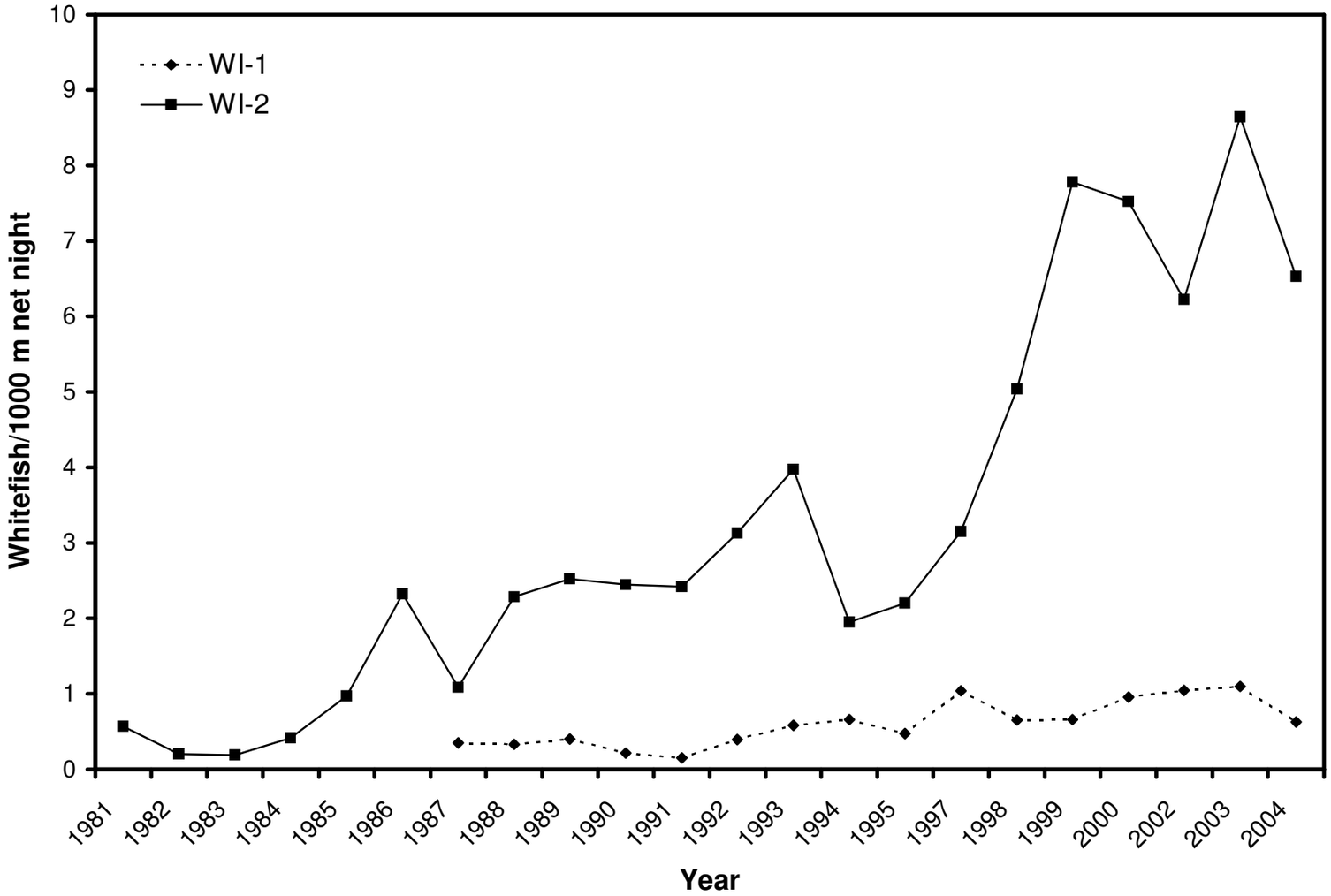

Figure 7. Geometric catch-per-unit-effort of whitefish in Wisconsin waters of Lake Superior, 1981-2004.